THE VASO MOTOR SYSTEM
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The osteopath is daily using the vaso-motor apparatus. Osteopathy differs from massage and medical gymnastics mainly in the fact that osteopathic manipulations aim at the active side of circulation, while the other systems aim at the passive side, especially the venous side of the circulation.

On the active side of the circulation there are two important factors to be taken account of; first, the heart. The heart has its own inherent rhythm, in virtue of which its muscles will contract rhytmically, the contraction passing from the auricles to the ventricles. The nervous sytem, therefore, in relation to the heart acts simply as a regulator of the contraction rate, the two nerve forces acting in such a way as to increase or to decrease the rate of the cardiac contraction.

The inhibitory action depends upon the constant and continuous activity of the 10th cranial nerve, functioning as it does from the cardiohinhibitory centre in the medulla, this centre being constantly active and acting under the stimulus of the arterial blood pressure. The accelerator centre is also located in the medulla; the neuraxons of the cells of this centre passing down the cord to the upper dorsal area, where a connection is established with the fibres that pass out through the spinal cells to the sympathetic ganglis, at the level of the first, second and third dorsal vertebrae, and thence to the heart. This centre acts under the stimulation of lessened peripheral resistance, and may be affected, therefore, by manipulation at the first, second and third dorsal vertebrae, while inhibitory pressure will decrease the accelerator action behind the heart.

The internal blood supply to the heart is an important factor in the regulation of the heart action. With the increase of the blood in the coronary system, the heart beats faster and stronger. This depends on the vaso-dilation of the coronary arteries, hence the vaso-motor nerves to these coronary arteries, arising from the third, fourth and fifth dorsal, have an important bearing upon the heart action. If the heart is subject to oppression or obstruction of any kind, inhibitory pressure at the third, fourth and fifth dorsal will dilate these coronary arteries and increase the action of the heart. According to most physiologist, the vagus nerve is vaso-motor to the coronary arteries, and this seems to explain the relation of the vagus nerve to the spine at the third, fourth and fifth dorsal area.

Secondly, the controlling centres of the heart act chiefly in connection with the peripheral resistance of the blood vessels. This peripheral resistance has a special method of registering itself in connection with these centres. When the pressure in the arteries rises, the pressure of the blood in the heart also rises, and this pressure arouses the terminals of the depressor nerve in the cardiac walls; the depressor nerve then conveys the knowledge of this rise in pressure to the cardio-inhibitory centre in the medulla, along the path of the depressor nerve. This impression is radiated to the vaso-constrictor centre as an inhibition, passing out to the periphery along the vaso motor path to lessen the pressure, and therefore to diminish the arterial peripheral resistance. In the case of lessened peripheral resistance, the heart feels the fall of pressure within its walls, and the depressor nerve conveys the intelligence to the medulla centre, with the result that the peripheral pressure is raised through the vaso-dilator system. The depressor nerve represents the sensory side of this cardiac reflex.

Thus we have, in all probability, a cycle of changes in connection with the circulation of the blood, in which the heart represents one important part, and the vaso-motor nervous systemthe other, an indespensible factor in the cycle. Without the integrity of this apparatus, the circulation of the blood would be impossible, so that the arterial sway which practically controls the blood, is the representative of vaso-motion. After the discovery of the muscular coat in the arterial walls, the foundation was laid for the demonstration of the fact that this muscular coat was innervated by a double set of fibres; the constrictor fibres lessening the calibre of the walls, and the dilator fibres increasing the calibre of the vessel walls. Hence, while the circulation of the blood depends upon the pumping action of the heart, its proper distribution in connection with the different functions of the circulation, such as nutrition and oxygenation, depends upong the action of the arterial vessels, the local needs being registered in connection with local and general vaso-motor influences. It is for this reason that the vaso-motor system is considered to be the most important part of the circulatory phenomena. The great vaso-motor centre is in the medulla, and the increase or decrease in the waves of vibration passing out from this centre determine the rise or fall in blood pressure all over the body.

In the spinal cord there are subordinate centres at the different segmental levels which are subject to the control of the medullary centres, but in the case of injury, where the medulla and spinal centres are cut off, the sympathetic ganglia cells will maintain the tone of the blood vessels after the shock has passed away, indicating that the true vaso-motor centres are in these ganglia. This means that the vaso-motor system contains three great classes of nerve cells. 1 The cells of the medulla, from which neuroaxons pass out to control 2 The cells of the spinal cord and brain at the different levels, from which the neuroaxons pass through the cranial and spinal nerves to 3 the cells in the sympathetic ganglia, from which the neuraxons pass directly as grey, or true, sympathetic fibres, to the muscles in the walls of the blood vessels. In this way the cerebro-spinal, spinal and sympathetic sytems are bound together in functioning the vaso-motor forces.

The Vaso-constrictor nerves pass as neuraxons from the medulla cells to the spinal cells. The neuraxons of these spinal cells pass out of the cord as white rami communicantes, along the anterior roots of the spinal nerves from the 2nd dorsal the 2nd lumber nerves inclusive, passing into the sympathetic ganglia, and from thence to be distributed as grey fibres.

The vaso-dilator nerves pass out along the cerebro-spinal axis along the cranial and spinal nerves, retaining their medullation as white fibres until their distribution in the blood vessels walls. Hence the vaso-dilators do not end in the sympathetic cells, but pass out with the anterior roots of the spinal and cranial nerves to their distribution.

The centres of vaso-dilator functions are found at the areas corresponding with the origin and exit of the vaso-dilator nerves from the cranial and spinal axis. Therefore, the vaso-constrictors are the great fibres which rise in the sympathetic ganglia, to be distributed to the visceral and cutaneous blood vessels. They are constantly acting in maintaining the tonic condition of the blood vessel walls, and in maintaining the uniformity of tension and pressure all over the haemic system. They are under the regulative control of the spinal cord cells and the great vaso-motor centre in the medulla, in connection with sensory stimuli coming from the different portions of the body. The influence of vaso-constriction is general and local, and in case of emergency the sympathetic ganglia cells can act independently, but in this case the action is purely local. The vaso-dilators are distinctly cerebro-spinal nerves which are distributed along with the motor nerves from all points, chiefly to the arteries in the muscular system. Having no general or common centre as a meeting place for sensory impulses, their action is purely local.

From this it is clear that while the vaso-motor mechanism includes the vaso-constrictors and vaso-dilator sides of the mechanism, it may be said to consist practically of vaso-constriction alone, having the general as well as the local action and alone representing the constant vaso-motor action. The general centre for vaso-constriction is located in the medulla which acts in response to sensory stimuli, and calls forth the motor phenomena.

Having established the three-fold centres of vaso-constriction as medullary, spinal and sympathetic, we have the basis for the transfer of sensory impulses to the three centres, and the foundation of the distribution of these impulses, so that the vessels in the deep and superficial areas of the body can be co-ordinated on the basis of constriction and relaxation.

The sympathetic ganglia are the true vaso-motor centres, from which pass out not only the visceral gray fibres to their distribution in the blood vessel walls, but also the grey rami communicantes, which pass to the spinal nerves to be distributed along with them to the skin and blood vessels of the superficial tissues. This means that by increasing or decreasing sensory stimulation in the superficial skin and muscles, the vaso-motor centres can be influenced so as to alter the functioning of the vaso-constrictors to the visceral organs and vice versa.

It has already been stated that the depressor nerve from the heart to the medulla represents the sentory, and inhibitory side of the vaso-motor apparatus, correlating and co-ordinating the heart with the arterial system. The vaso-motor activity depends, therefore, upon the sensory stimulation which must be intact. It has been well established that probably the majority of the disturbances found under the head of disease begin on the sensory side of the nervous system; thus the involvement of the vaso-motors is frequently secondary. For example, in paralytic conditions of the vaso-constrictors, resulting in stasis of blood in a local area, and followed by congestion and inflammation, the best way to relieve this condition is through the sensory side of the nervous system, in order to relieve the centre of vaso-motor paresis.

As the vaso-motor nerves represent the selective side of the nutritive processes and the secretory functions in connection with the blood, these represent important influences bearing upon nutrition and secretion. This means that the minute capillary circulation of the tissues depends on the vaso-motor activity. The vaso-constrictor influence exerted upon the arterioles increases the capillary resistance, thus lessening the blood pressure within the capillaries and increasing the capillary contractile tension, while the lessening of the vaso-constrictor influence in the arterioles decreases the capillary resistance, and increases pressure in the capillaries. In this way, a larger volume of blood is allowed to pass through the capillaries, and if this is found over an extensive area of the body the reaction will affect the heart.

Therefore, if vaso-constrictor force is increases, resistance to the passage of the blood is increases peripherally, and in order to relieve the heart, dilation of the arterioles in some other part of the body takes place in connection with the sensory stimulation carried from the heart to the vaso-motor centre in the medulla by the depressor nerve. It is in this way that the superficial and deep arterioles balance each other. In line with this vaso-constriction of the superficial blood vessels tends to slow the heart, on account of the greater work demanded against the increases resitance, and this can only be relieved by the dilation of the visceral blood vessels in connection with the splanchnic vaso-motors, and vice versa. This means that the vaso-motor centre in the medulla acts as a great regulator of the vaso-motion of the blood vessels under the stimulating influences reacing it along the sensory paths from all parts of the body. In time this great centre influences the subordinate spinal vaso-motor centres, but these centres are aslo subject to local senory stimuli from the segmental areas, which are governed from the local area. Hence the centres of vaso-motion are subject to the stimulating influences arising from the different parts of the body, which can be reached for osteopathic purposes in the skin, sub-cutaneous fascia, muscles, glands and viscera.

As we have seen there are two pathways along which the vaso-motor influences reach the blood vessel walls; either directly through the spinal nerves, or indirectly through the sympathetics. These are the vaso-constrictor nerves; the vaso-dilator nerves pass out of the spinal cord along the posterior roots of the nerve trunks. Irritation of the dilator, or complete inhibition of the constrictor nerves will cause dilation of the arterioles, resulting in what is called active hyperaemia. This may be due to muscular or osseous lesions in the spine, which, again, may be due to some irritation in the mucous membrane of the alimentary tract. In the latter case it is called a reflex hyperaemia. This means that the vasodilator nerves accompany the sensory nerves in their distribution to the muscles, mucous membranes, cells and glands. This is for physiological purporses, such as in the dilation of the blood vessels in the stomach during the periord of active digestion. If this process, and the resultant is in excess or uncontrolled, there may be sensory irritation along the spine in the stomach area, accompanied by hyperaemia and hyperaesthesia. The vasomotors then, are divided into constrictors and dilators, which represent the motor control of the blood vessels and are complementary to each other. In treatment the constrictor is the major factor.

The superficial and deep circulations are also complementary to one another, the vaso-constriction of the superficial being counteracted by the dilation of the deep circulation, and vice-versa. Osteopathically, therefore, the treatment may be divided into two parts 1) Steady pressure to cut off the sensory impulses passing from the cutaneous and other sensory nerves to the vaso-motor centres, in order to check the sensory nerve action. 2) The rhytmic treatment of the muscles to remove contractions and so prevent the blood from being checked in its advance to the superficial cutaneous blood vessels. This treatment consits of alternated inhibition and stimulation.

For the purposes of vaso-motion, the spine is divided up into regions. Strong pressure in the sub-occiput over the nerves which communicate with the great centre in the medulla relieves congestive conditions in the head, and co-ordinates the calibre of the vessels throughout the body, thus distributing the excess of blood retained in the brain in a state of static congestion. In other words the sub-ocipital pressure diminishes the blood pressure in the entire circulatory system. This pressure has a triple effect; 1) the inhibitory pressure ove the minute filaments checks the sensory stimuli passing into the medulla. 2) Controls and co-ordinates the local cpaillary circulation, which is freely connected with the medulla, both from the blood and nerve standpoints, and thus affects the entire vaso-motor system. When the number of stimuli is diminished and the capillaries are relaxed so as to contain a larger volume of blood, the irritation to the medulla centres is removed, and the blood and nerve supplies become normal. 3) In addition, inhibitory pressure in the sub-occipital region produces a counteraction of the superficial body constriction, thus dilating the superficial blood vessels, and preventing the excess of blood from circulating in the cutaneous arteries and capillaries.